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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/594,683

09/28/2006

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Q80899

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23373 7590 04/01/2008  
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EXAMINER

QUINTO, KEVIN V

ART UNIT

PAPER NUMBER

2826

MAIL DATE

DELIVERY MODE

04/01/2008

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/594,683	<b>Applicant(s)</b> UDAGAWA, TAKASHI	
	<b>Examiner</b> Kevin Quinto	<b>Art Unit</b> 2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☒ Responsive to communication(s) filed on 11 October 2007.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-9 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,3 and 5-9 is/are rejected.
- 7) ☒ Claim(s) 2 and 4 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 28 September 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>28 September 2006</u> .                                       | 6) <input type="checkbox"/> Other: _____                          |

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 3, and 5-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kryliouk et al. (United States Patent Application Publication No. US 2005/0087746 A1) in view of Utsumi et al. (USPN 5,766,783).

3. In reference to claim 1, Kryliouk et al. (United States Patent Application Publication No. US 2005/0087746 A1, hereinafter referred to as the "Kryliouk" reference) disclose a similar compound semiconductor device. Figure 1(b) of Kryliouk discloses a boron-phosphide-based (111) semiconductor layer (160) stacked in parallel on a (111) Si substrate (105). Kryliouk does not disclose the use of a hexagonal silicon carbide substrate with a {0001} crystal plane. However Utsumi et al. (USPN 5,766,783, hereinafter referred to as the "Utsumi" reference) shows that an Si (111) substrate and a hexagonal silicon carbide substrate with a {0001} crystal plane are equivalent structures for growth of group III nitrides (column 7, lines 62-67, column 8, lines 1-9) in the art. Therefore, because these two substrates were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute a hexagonal silicon carbide substrate with a {0001} crystal plane

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for an Si (100) substrate. Kryliouk and Utsumi teach all of the claimed invention except for the exact thickness of the boron-phosphide-based semiconductor layer. Although Kryliouk and Utsumi do not teach the exact thickness as that claimed by Applicant:

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

The shape, size, dimension differences are considered obvious design choices and are not patentable unless unobvious or unexpected results are obtained from these changes. It appears that these changes produce no functional differences and therefore would have been obvious. Note *In re Leshin*, 125 USPQ 416.

Therefore claim 1 is not patentable over Kryliouk and Utsumi.

4. With regard to claim 3, the boron-phosphide-based semiconductor layer (160) is undoped (p. 2, paragraph 26).

5. In reference to claim 5, Kryliouk (United States Patent Application Publication No. US 2005/0087746 A1) discloses a similar fabrication process for a compound semiconductor device. Figure 1(b) of Kryliouk discloses (p. 3, paragraphs 35-36) feeding at least a boron-containing compound and a phosphorus-containing compound into a vapor phase growth zone to form a boron-phosphide-based (111) semiconductor layer (160) stacked in parallel on a (111) Si substrate (105). Kryliouk does not disclose the use of a hexagonal silicon carbide substrate with a {0001} crystal plane as the base layer. However Utsumi (USPN 5,766,783) shows that an Si (111) substrate and a hexagonal silicon carbide substrate with a {0001} crystal plane are equivalent structures for growth of group III nitrides (column 7, lines 62-67, column 8, lines 1-9) in the art. Therefore, because these two substrates were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to

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substitute a hexagonal silicon carbide substrate with a {0001} crystal plane for an Si (100) substrate. Kryliouk and Utsumi teach all of the claimed invention except for the exact thickness of the boron-phosphide-based semiconductor layer. Although Kryliouk and Utsumi do not teach the exact thickness as that claimed by Applicant:

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

The shape, size, dimension differences are considered obvious design choices and are not patentable unless unobvious or unexpected results are obtained from these changes. It appears that these changes produce no functional differences and therefore would have been obvious. Note *In re Leshin*, 125 USPQ 416.

Therefore claim 1 is not patentable over Kryliouk and Utsumi.

6. In reference to claim 6, the boron-phosphide-based semiconductor layer (160) is formed at 850°C-1100 °C. The examiner would like to note:

In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). See MPEP 2144.05.

Thus claim 6 is not patentable over Kryliouk and Utsumi.

7. With regard to claims 7 and 8, Kryliouk and Utsumi do not disclose the exact rate claimed by the applicant. However:

"[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Therefore claims 7 and 8 are not patentable over Kryliouk and Utsumi.

8. In reference to claim 9, Kryliouk (United States Patent Application Publication No. US 2005/0087746 A1) disclose a similar diode. Figure 1(b) of Kryliouk discloses a diode with a doped (p. 2, paragraph 26) boron-phosphide-based (111) semiconductor

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layer (160) stacked in parallel on a (111) Si substrate (105). It is understood that the boron-phosphide-based semiconductor layer is n-type since it is in between two n-type layers, one of which is coupled to the n-electrode. Kryliouk does not disclose the use of a hexagonal silicon carbide substrate with a {0001} crystal plane. However Utsumi (USPN 5,766,783) shows that an Si (111) substrate and a hexagonal silicon carbide substrate with a {0001} crystal plane are equivalent structures for growth of group III nitrides (column 7, lines 62-67, column 8, lines 1-9) in the art. Therefore, because these two substrates were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute a hexagonal silicon carbide substrate with a {0001} crystal plane for an Si (100) substrate. Kryliouk and Utsumi teach all of the claimed invention except for the exact thickness of the boron-phosphide-based semiconductor layer. Although Kryliouk and Utsumi do not teach the exact thickness as that claimed by Applicant:

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

The shape, size, dimension differences are considered obvious design choices and are not patentable unless unobvious or unexpected results are obtained from these changes. It appears that these changes produce no functional differences and therefore would have been obvious. Note *In re Leshin*, 125 USPQ 416.

Therefore claim 9 is not patentable over Kryliouk and Utsumi.

***Allowable Subject Matter***

9. Claims 2 and 4 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

10. The following is a statement of reasons for the indication of allowable subject matter: the examiner is unaware of any prior art which suggests or renders obvious a compound semiconductor device with a hexagonal silicon carbide crystal substrate with a {0001} crystal plane, and a {111} crystal boron-phosphide-based semiconductor layer stack formed on the silicon carbide crystal substrate crystal substrate such that the number of the layers contained in one periodical unit of an atomic arrangement in the {0001} crystal orientation of the silicon carbide crystal substrate is  $n$ , with an  $n$ -layer-stacked structure included in the {111} crystal plane forming the {111} crystal has a stacking height virtually equal to the  $c$ -axis lattice constant of the silicon carbide crystal substrate while also having the explicit stack with regard to the  $a$ -axis and having the suggested twinning plane as described in claims 2 and 4.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kevin Quinto whose telephone number is (571)272-1920. The examiner can normally be reached on M-F 8AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sue Purvis can be reached on (571) 272-1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Kevin Quinto/  
Examiner, Art Unit 2826

/A. Sefer/  
*Primary Examiner*  
*Art Unit 2826*